

The National Institute for Occupational Safety and Health (NIOSH)

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NIOSH Research Rounds

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Identifying Workplace Chemical Exposures to Help Prevent Birth Defects

To learn whether exposure to potentially hazardous chemicals in the workplace increases the risk of birth defects, NIOSH researchers are partnering with the Centers for Birth Defects Research and Prevention (CBDRP) on one of the largest birth-defects prevention research efforts in the nation. NIOSH researchers hope to address some key questions:

- Which workplace chemicals contribute to specific birth defects?
- What level of chemical exposure contributes to birth defects?
- When is chemical exposure likely to cause birth defects?
- What workplace factors other than chemical exposure might be involved?

The CDC's [National Center on Birth Defects and Developmental Disabilities](#) is funding and coordinating the research. The first part, called the [National Birth Defects Prevention Study \(NBDPS\)](#), collected information from voluntary participants about health and lifestyle, including their work before and during pregnancy. Between 1997 and 2011, more than 30,000 mothers of babies with birth defects, identified through population-based birth defects surveillance systems, and 10,000 mother of babies without birth defects participated in the study.

Recent findings from the study suggest that work-related exposure to fungicides, insecticides, and herbicides are unrelated to most birth defects of the heart that are included in NBDPS. However, researchers found a connection between a few rare heart birth defects and above-average exposure levels to some of these pesticides. For example, mothers of children with one type of birth defect were 5 times as likely as mothers of children without birth defects were to have encountered higher doses of insecticides and herbicides. This birth defect, called hypoplastic left heart syndrome, impairs normal blood flow through the heart.

The study included diverse occupations, including those involved in chemical production and use, such as agriculture, landscaping, lawn care, and pest extermination. Researchers estimated exposures using factors that include the levels of exposure typically associated with specific types of job tasks performed by the women, how long the women held their jobs, and how many hours per week they worked—from 1 month before pregnancy through the end of their first trimester.

Researchers continue to investigate which specific chemicals and exposure levels may have contributed to an increased risk for this heart birth defect. They have also studied whether other factors, such as family history of heart birth defects or the mother's age, may have played a role.

These investigations have helped inform the occupational questionnaire modules of a related study, the [Birth Defects Study to Evaluate Pregnancy exposureS \(BD-STEPs\)](#). For this study, voluntary participants will answer questions specific to their occupation and workplace, as well as general questions about health and lifestyle. With this information, NIOSH and CBDRP researchers will be better able to assess the level and timing of chemical exposures. This is the first step in identifying and preventing birth defects related to chemical exposure at work. As the researchers learn more about how workplace exposures affect pregnancy, they share this information with their colleagues by publishing scientific papers in peer-reviewed journals, and they inform the public on the [NIOSH Reproductive Health and the Workplace](#) and partners' webpages.

To learn more, visit these websites:

- [NIOSH Reproductive Health and the Workplace](#)
- [National Birth Defects Prevention Study](#)
- [Birth Defects Study to Evaluate Pregnancy exposureS](#)
- [National Center for Birth Defects and Developmental Disabilities](#)

To read recent journal articles, go to:

- [Maternal Occupational Exposure to Polycyclic Aromatic Hydrocarbons and Craniosynostosis Among Offspring in the National Birth Defects Prevention Study](#) [↗](#)
- [Maternal Occupational Exposure to Polycyclic Aromatic Hydrocarbons and Small for Gestational Age Offspring](#) [↗](#)
- Also available at: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4497781/> [↗](#)
- [Maternal Occupational Pesticide Exposure and Risk of Congenital Heart Defects in the National Birth Defects Prevention Study](#) [↗](#)

New Findings Support Changes to Firefighter Apparatus and Glove Design

When others rush out from burning buildings, firefighters go in to save lives. More knowledge and better resources can help keep firefighters safe. NIOSH contributes to firefighter safety by scientifically studying body measurements, which is known as "anthropometric research." This research can be used when redesigning fire trucks and developing better-fitting personal protective equipment.

NIOSH researchers recently collected body dimension data on 951 U.S. firefighters to [assess how well fire apparatus seat and seat belt designs accommodate current firefighters](#). This was the first national study of this type on firefighters. Findings may affect the design of fire apparatus, as well as fire apparatus standards. Three primary safety issues can involve fire apparatus:

1. **Seatbelts are too short** to allow many firefighters to buckle up when in turnout gear.
2. **Seats do not adequately fit firefighters in turnout gear** and may compromise safety when all seats in the cab are occupied.
3. Vehicles lack **head supports**, which reduce neck injuries in rear-impact crashes.

The most recent revision of the National Fire Protection Association (NFPA) standards updated a specification for seatbelt length. However, as it updates standards, the NFPA Technical Committee on Fire Apparatus is still considering safety issues involving seats and head supports.

Along with fire apparatus, the researchers studied the [fit of structural firefighting gloves](#) [↗](#) [↗](#) to accommodate today's firefighters. Findings showed that nearly 1 in 3 men (31%) and almost 2 in 3 women (62%) reported problems with the fit or bulkiness of the gloves. As a result, NIOSH proposed improving the way structural firefighting gloves are sized.

NIOSH expects to release detailed data on its website by the end of 2015.

For a summary of firefighter anthropometry data, go to the journal [Human Factors](#) [↗](#) [↗](#).

Are Face Masks Safe During Pregnancy?

Worldwide, millions of pregnant women wear face coverings at work, including the widely used N95 respirator with filtering face pieces or masks. The N95 respirator restricts normal airflow, so a woman may have to breathe harder while wearing it. NIOSH researchers are working to answer an important question: Does an N95 filtering face piece put more physical stress on a pregnant woman who wears it?

NIOSH researchers studied whether pregnant women who wear an N95 respirator have different health effects than women who are not pregnant. Researchers took steps to ensure that the tests did not themselves create a risk for harm. They monitored 16 pregnant and 16 non-pregnant voluntary participants for heart rate, blood pressure, fetal heart rate, and other indicators of heart and lung function. The research included 1 hour of alternating sitting, standing, and moderate exercise on a stationary bicycle, both with and without a filtering facepiece respirator mask. All study participants were healthy non-smokers.

For the two groups, researchers observed no noteworthy differences in how the hearts and lungs of the participants performed. However, both pregnant and non-pregnant women wearing the respirator mask had a mild—but significant—**increase in the heart's resting, or diastolic, blood pressure**. The temporary increase did not affect heart and lung function, so it is unlikely to cause health problems in healthy women, the researchers said.

More research could help determine whether pregnant women with pregnancy-related high blood pressure and those with chronic high blood pressure can safely wear face coverings. Additional studies also should examine whether comparable indicators from the 1-hour tests occur over a longer period.

To read the full journal article, go to [Effect of External Airflow Resistive Load on Postural and Exercise-associated Cardiovascular and Pulmonary Responses in Pregnancy: a Case Control Study](#) [↗](#).

Biomarkers Could Clarify Chemical Exposure Levels

In the United States, about 82,000 chemicals are available to use, often in the workplace. Since little is known about the harmful effects of these chemicals—either alone, or combination—research is needed to determine safe chemical exposure levels for workers. Identifying early changes, or biomarkers, that occur in the body after exposure but before disease develops could help identify workers who are at risk.

In a new paper, NIOSH investigators review current studies of biomarkers of early effects in risk assessment. We asked co-author and NIOSH science officer Gayle DeBord to explain the findings.

Q: What did you learn from this review?

A: Two scientific approaches to studying early biological effects offer promise for the future of risk assessment. These approaches are systems biology, which provides information from multiple cellular pathways in concert, and computational toxicology, which combines this information in computer models to assess risk. Using advanced scientific procedures to identify changes in proteins, genetic materials, and biological pathways, scientists can generate information on the biological effects of chemical exposure. These newer methods can provide greater information more quickly and cheaply than conventional methods can.

Q: What are the challenges facing the field of biomarkers in risk assessment?

A: We still need to overcome several challenges, such as standardization and validation of the biomarkers before routine risk assessments can rely on these methods.

Q: What are the next steps?

A: Preliminary studies in computational toxicology show that early biomarkers could help establish dose and mode of action, but we need more research to validate these biomarkers.

To read the full journal article, go to [Systems Biology and Biomarkers of Early Effects for Occupational Exposure Limit Setting](#) [↗](#).

For more information about chemical safety, visit [NIOSH International Chemical Safety Cards](#).

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